

Australian Standard™

Dependability management

Part 2: Guidance for dependability programme management



This Australian Standard was prepared by Committee QR-005, Dependability. It was approved on behalf of the Council of Standards Australia on 8 April 2005. This Standard was published on 5 May 2005.

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Part 2: Guidance for dependability programme management

Originated as part of AS 3930—1992 and AS 3960—1990.
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AS IEC 60300.2—2005.

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PREFACE

This Standard was prepared by Standards Australia Committee QR-005, Dependability.

This Standard is identical with, and has been reproduced from IEC 60300-2, Ed.2.0 (2004), *Dependability management—Part 2: Guidelines for dependability management*. It supersedes AS 3930—1992, *Reliability and maintainability – Introductory guide* and AS 3960—1990, *Guide to reliability and maintainability program management*.

‘Dependability’ is a collective term for performance characteristics (reliability, availability, maintainability) of simple or complex products and systems. The AS IEC 60300 series of dependability management system Standards provide general guidelines for establishing a dependability management system to meet most organizational or project needs, supported by a ‘tool kit’ of non-prescriptive guidance Standards on a range of dependability applications and methods.

The objective of this Standard is to provide guidelines on managing dependability programmes. This Standard discusses planning and implementation of a dependability programme to meet specific product requirements for reliability, maintainability and life cycle cost. It identifies the process steps and essential features of dependability management, and links them to processes and methods relevant to a wide range of products. It supports Part 1 of the dependability management system Standard, AS IEC 60300.1, and is compatible with AS/NZS ISO 9001.

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- (a) Its number does not appear on each page of text and its identity is shown only on the cover and title page.
- (b) In the source text ‘this part of IEC 60300’ should read ‘this Australian Standard’.

Reference to International Standards should be replaced by references to Australian or Australian/New Zealand Standards, as follows:

<i>Reference to International Standard</i>		<i>Australian/New Zealand Standard</i>	
IEC		AS IEC	
60300	Dependability management	60300	Dependability management
60300-1	Part 1: Dependability management systems	60300-1	Part 1: Dependability management systems
60300-3-1	Part 3-1: Application guide—Analysis techniques for dependability—Guide on methodology	60300.3.1	Part 3.1: Application guide—Analysis techniques for dependability—Guide on methodology
61014	Programmes for reliability growth	61014	Programmes for reliability growth
ISO/IEC		AS/NZS	
15026	Information technology—System and software integrity levels	15026	Information technology—System and software integrity levels

Only international references identical to Australian or Australian/New Zealand Standards have been listed.

The term ‘informative’ has been used in this Standard to define the application of the annex to which it applies. An ‘informative’ annex is only for information and guidance.

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INTRODUCTION

Dependability deals with the availability performance of a product. The factors influencing availability performance are reliability, maintainability and maintenance support performance. Dependability is a technical discipline that needs to be managed in order to achieve its objectives and benefits. Dependability management should provide a clear customer focus. It should be incorporated into an organization's overall management system to coordinate dependability activities for cost-effective results.

This part of IEC 60300 provides guidelines on dependability management. It supports the top-level dependability management system standard IEC 60300-1 by identifying and referencing relevant processes and methods for a broad range of products. This standard links the management process steps with applicable dependability standards to foster continual improvement.

The concept of product life cycle is introduced to deal with the significance of dependability activities and timing for their effective implementation. The association of product life cycle phases with the applicable dependability programme elements and tasks are presented to facilitate tailoring of dependability programmes to meet specific project needs.

This standard outlines the generic process for dependability applications based on successfully applied industry practices. It can be incorporated into the management systems of large corporations as well as being adaptable to small businesses.

Time-dependent reliability, maintainability and maintenance support performance characteristics in products are addressed.

This standard references other published TC 56 standards and also makes reference to several ISO/IEC standards as well as some sector specific reliability standards. These references are listed in the bibliography.

Annex A provides a summary description of the elements and tasks of a dependability programme for application.

Annex B defines the product life cycle phases.

Annex C presents an association of product life cycle phases with the applicable dependability elements and tasks.

Annex D presents process steps and standards for managing dependability.

Annex E provides a list of questions to facilitate dependability management review.

Annex F provides guidelines for the tailoring process.

Annex G presents the classification of dependability standards with the life cycle phases.

STANDARDS AUSTRALIA

Australian Standard**Dependability management****Part 2: Guidance for dependability programme management**

1 Scope

This part of IEC 60300 provides guidelines for dependability management of product design, development, evaluation and process enhancements. Life cycle models are used to describe product development or project phases. A tailoring process is recommended for the selection of relevant dependability programme tasks for time-phased implementation to meet varied user needs.

This part of IEC 60300 is applicable for detailed planning and implementation of a dependability programme to meet specific product needs. The tailoring process provides a method for selection of dependability programme elements and associated processes from a product or project perspective. This standard is applicable to all organizations, during all life-cycle phases and in any contract situation, regardless of type, size and product provided.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60300-3-1, *Dependability management – Part 3-1: Application guide – Analysis techniques for dependability – Guide on methodology*

IEC 61014, *Programmes for reliability growth*

ISO/IEC 15026, *Information technology – System and software integrity levels*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

NOTE 1 Certain terms and definitions are taken from IEC 60050(191) and IEC 60300-1.

NOTE 2 ISO 9000 is used as a reference to quality vocabulary.

3.1**dependability**

collective term used to describe the availability performance and its influencing factors: reliability performance, maintainability performance and maintenance support performance

NOTE Dependability is used only for general descriptions in non-quantitative terms.

[IEC 60050, 191-02-03]

3.2**dependability management**

coordinated activities to direct and control an organization with regard to dependability

NOTE Dependability management is part of an organization's overall management.

[IEC 60300-1, definition 3.2]

3.3 dependability management system

management system to direct and control an organization with regard to dependability

NOTE 1 The dependability management system of an organization is part of its overall management system.

NOTE 2 The organizational structure, responsibilities, procedures, processes and resources used for managing dependability are often referred to as a dependability programme.

[IEC 60300-1, definition 3.3]

3.4 dependability plan

document setting out the specific dependability practices, resources and sequences of activities relevant to a particular product, contract or project

[IEC 60300-1, definition 3.4]

3.5 dependability programme element

set of dependability programme tasks, pertaining to a specific subject area

3.6 dependability programme task

set of activities addressing specific dependability aspects of a product

3.7 product

result of a process

NOTE 1 There are four generic product categories, as follows:

- services (e.g. transport);
- software (e.g. computer program, dictionary);
- hardware (e.g. engine mechanical part);
- processed materials (e.g. lubricant).

Many products comprise elements belonging to different generic product categories. Whether the product is then called service, software, hardware or processed material depends on the dominant element. For example, the offered product "automobile" consists of hardware (e.g. tyres), processed materials (e.g. fuel, cooling liquid), software (e.g. engine control software, driver's manual), and service (e.g. operating explanations given by the salesman).

NOTE 2 Service is the result of at least one activity necessarily performed at the interface between the supplier and customer and is generally intangible. Provision of a service can involve, for example, the following:

- an activity performed on a customer-supplied tangible product (e.g. automobile to be repaired);
- an activity performed on a customer-supplied intangible product (e.g. the income statement needed to prepare a tax return);
- the delivery of an intangible product (e.g. the delivery of information in the context of knowledge transmission);
- the creation of ambience for the customer (e.g. in hotels and restaurants).

Software consists of information and is generally intangible and can be in the form of approaches, transactions or procedures.

Hardware is generally tangible and its amount is a countable characteristic. Processed materials are generally tangible and their amount is a continuous characteristic. Hardware and processed materials often are referred to as goods.

NOTE 3 Quality assurance is mainly focussed on intended product.

[ISO 9000, definition 3.4.2]

NOTE 4 In the context of dependability, a product may be simple (e.g. a device, a software algorithm) or complex (e.g. a system or an integrated network comprising hardware, software and human elements and support facilities and activities).

[IEC 60300-1, definition 3.5]

3.8 system

set of interrelated or interacting elements

[ISO 9000, definition 3.2.1]

NOTE 1 In the context of dependability, a system will have

- a) a defined purpose expressed in terms of intended functions,
- b) stated conditions of operation/use,
- c) defined boundaries.

NOTE 2 The structure of a system may be hierarchical.

[IEC 60300-1, definition 3.6]

3.9 reliability (performance)

ability of an item to perform a required function under given conditions for a given time interval

[IEC 60050, 191-02-06, modified]

3.10 maintainability (performance)

ability of an item under given conditions of use, to be retained in, or restored to, a state in which it can perform a required function, when maintenance is performed under given conditions and using stated procedures and resources

[IEC 60050, 191-02-07, modified]

3.11 maintenance support performance

ability of a maintenance organization, under given conditions, to provide upon demand, the resources required to maintain an item, under a given maintenance policy

[IEC 60050, 191-02-08, modified]

3.12 integrity level

denotation of a range of values of a property of an item necessary to maintain system risks within tolerable limits

NOTE For items that perform mitigating functions, the property is the reliability with which the item has to perform the mitigating function. For items whose failure can lead to a threat, the property is the limit on the frequency of the failure.

[ISO/IEC 15026, definition 3.9 modified]

3.13 item

entity

any part, component, device, subsystem, functional unit, equipment or system that can be individually considered

NOTE An item may consist of hardware, software or both, and may also in particular cases, include people.

[IEC 60050, 191-01-01, modified]

3.14**process**

set of interrelated activities utilizing resources to transform inputs into outputs

NOTE 1 Inputs to a process are generally outputs of other processes.

NOTE 2 Processes in an organization are generally planned and carried out under controlled conditions to add value.

NOTE 3 A process where the conformity of the resulting product cannot be readily or economically verified is frequently referred to as a "special process".

[ISO 9000, definition 3.4.1, modified]

3.15**supply-chain**

coordinated set of management processes linking the activities of the supplier, the organization and the customer to meet a common objective

3.16**management**

coordinated activities to direct and control an organization

NOTE In English, the term "management" sometimes refers to people, i.e. a person or group of people with authority and responsibility for the conduct and control of an organization. When "management" is used in this sense it should always be used with some form of qualifier to avoid confusion with the concept "management" defined above. For example, "management shall..." is deprecated whereas "top management shall..." is acceptable.

[ISO 9000, definition 3.2.6]

3.17**top management**

person or group of people who directs and controls an organization at the highest level

[ISO 9000, definition 3.2.7]

3.18**review**

activity undertaken to determine the suitability, adequacy and effectiveness of the subject matter to achieve established objectives

NOTE Review can also include the determination of efficiency.

EXAMPLE Management review, design and development review, review of customer requirements and nonconformity review.

[ISO 9000, definition 3.8.7]

3.19**life cycle**

time interval between a product's conception and its disposal

[IEC 60300-3-3, definition 3.1]

4 Dependability management system

The dependability management system is part of the overall management system of an organization. It provides an organizational framework for strategic direction of dependability policy, control of dependability functions and coordination of all dependability activities. Early attention to dependability plans and allocation of appropriate resources is needed for tailoring of effort to achieve the desired dependability objectives. To ensure dependability of a product, it is essential that reliability and maintainability are designed into the product and verified for their acceptance at various stages of the product realization process. Appropriate maintenance support effort is needed to sustain dependability in product applications, where available technology does not allow failure-free life cycles.

The dependability management system should provide a product life cycle framework for implementation of appropriate dependability programmes (see 3.3, Note 2) to meet the organization's business objectives, including customer satisfaction. The product life cycle reflects an end-to-end process; from product inception through development and operation to its end-of-life or withdrawal from use. The life cycle process provides a useful framework to group related dependability programme elements and tasks.

The process steps for managing dependability are presented in the top-level dependability management standard IEC 60300-1. They include:

- defining dependability objectives;
- analysis of the scope of dependability work needed and implications;
- planning strategy and activities to achieve dependability objectives;
- implementation of selected dependability tasks;
- analysis of results of dependability tasks implemented;
- evaluation of achieved dependability results for further improvement.

A typical process flow diagram is shown in Figure 1. The applicable dependability standards associated with each process step are presented in Annex D.

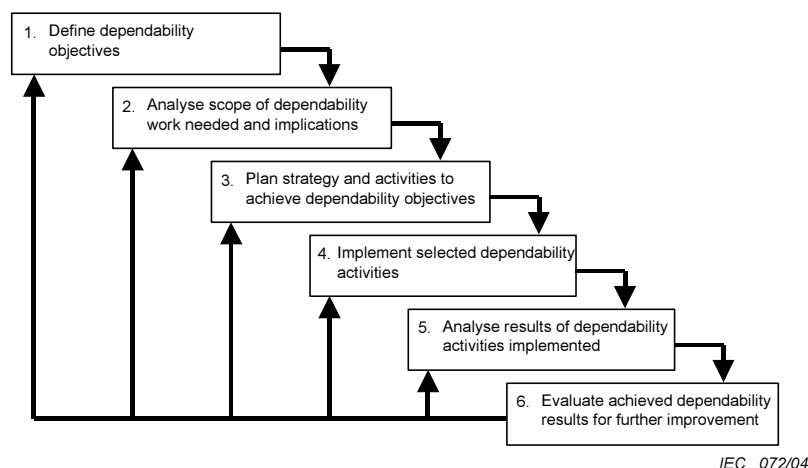


Figure 1 – Process steps for managing dependability

The product life cycle phases are described in Annex B. The interrelationship of product life cycle phases and the associated system life cycle processes as applied to project planning should be understood. This relationship is established by partitioning the product life cycle phases (see Annex C) in the time domain and the system life cycle processes in the function domain.

Product life cycle phases help address the time-phased management issues associated with the involvement of dependability programme tasks at each product life cycle phase: concept, development, production, operation and maintenance and disposal.

System life cycle processes help identify the activities of specific management and technical functions involved in acquisition, supply, planning and control, design, construction, evaluation and assessment.

The dependability management system should be adaptive to meet changing business needs. The objective of a flexible management infrastructure is to maximize available resources and to ensure timeliness in meeting project commitments. Long-term projects involving dependability may be managed through deployment of core resources. Core dependability groups may be maintained for retention of critical competence within the organization.

Additional competence may be sought through contracting to meet special project needs. Joint ventures, alliances in research consortia and subcontracting dependability tasks are commonly employed in a dynamic organization to meet competitive business demands.

5 Management responsibility

5.1 Management function on dependability

The management function on dependability should be identified with specific roles and objectives in relation to quality and other technical disciplines as needed by the organization or project. Top management of the organization is accountable for all dependability results. Routine day-to-day dependability activities are normally coordinated by technical project personnel assignments to meet specific needs.

a) Top management should:

- establish vision and strategy on dependability consistent with the organization's business;
- set dependability policy and communicate its direction, values and commitments to the organization, suppliers and customers;
- create an environment and infrastructure for promotion, understanding and cost-effective implementation of dependability management system and processes;
- provide adequate resources to support dependability programmes, development and maintenance of knowledge base;
- establish criteria for performance measurement on dependability achievement;
- focus on customer satisfaction and encourage information feedback for continual improvement.

b) Personnel managing dependability programmes should:

- be competent and knowledgeable in dealing with the dependability issues involved;
- be familiar with the organization's dependability policy, processes and methods;
- understand the objectives of the dependability programme;
- recognize the importance of interfaces with the customers and suppliers;
- ensure adequate resources to support commitments and delivery schedules;
- plan and implement work programmes for meeting dependability objectives;
- tailor the specific dependability programmes to meet customer's needs;
- assign competent staff to work on dependability activities;
- monitor process inputs and outputs to verify effectiveness of implementation;
- evaluate work performance and progress, and report results for management review;
- identify risks and problem areas associated with dependability for management review and resolution;
- implement preventive and corrective actions for continual improvement;
- conduct data analysis to facilitate process improvement and knowledge base enhancement.

5.2 Meeting customer dependability needs

The needs and expectations of the customers on dependability issues should be translated into objectives for formulating a specific dependability programme. Customer needs and expectations on dependability should be fully understood and converted to actionable dependability programme tasks by means of a tailoring process. Where applicable, early customer involvement in project planning may be essential to ensure achieving customer confidence. A record of dependability issues should be maintained and should be regularly reviewed to ensure timely resolution of problems that may directly or indirectly affect

dependability results. A review process should be put in place on closure of action items. The aim is to seek continual improvement by prompt corrective actions and initiation of effective preventive measures to avoid problem reoccurrence.

Meeting customer needs and expectations also demands proper deployment of resources and assignment of dedicated technical responsibilities.

5.3 Dependability policy and regulatory implications

Some dependability-related activities may be determined by regulatory and statutory requirements. These obligations are usually reflected in the organizational policy dealing with dependability and related issues. Personnel assigned to dependability tasks should be aware of such situations and act accordingly. Typical regulatory and statutory issues involving dependability include but are not limited to the following:

- potential liability issues due to non-compliance;
- potential liability issues due to failure of product (i.e. loss of mission, compromised safety or breach of security);
- identifiable risks associated with disposal of items;
- control of wastes and by-products that may impact the environment;
- “take-back” and “buy-back” conditions in maintenance contracts of previously supplied materials.

NOTE A “take-back” condition exists when, for example, the organization agrees to remove or take back old equipment before the customer purchases new ones. A “buy-back” condition exists when, for example, the organization agrees to refund the customer or buy-back the surplus spares not consumed at the end of a maintenance support contract.

5.4 Dependability programmes

A tailoring process should be used to ensure adequate selection and timely implementation of relevant dependability programme tasks during all applicable product life cycle phases. This is in order to achieve an effective dependability programme, to enhance total system availability performance, and to realize the dependability objectives. The overall objective is to deliver customer value through strategic planning and deployment of interrelated quality processes and dependability programme tasks to meet customer needs and satisfaction. Dependability programmes need to be funded and supported with adequate resources and facilities.

5.5 Management representative

A management representative may be appointed and given authority by top management to manage, monitor, evaluate and coordinate the dependability management system. This appointment is to enhance effective and efficient operation and improvement of the dependability management system. The representative should report to top management and may communicate with customers and other interested parties on matters pertaining to the dependability management system.

5.6 Management review

Top management should review the dependability management system on a regular basis to determine the continuing suitability of the organization’s dependability policy, objectives and system.

The frequency of these reviews should be determined by the needs of the organization. Outputs from reviews should provide data for use in planning for performance improvement of the organization. Dependability management review records should be maintained as part of the improvement process.

6 Resource management

6.1 Provision of resources

The organization should provide adequate resources to sustain an effective dependability management system to meet business objectives. The major resources needed to support dependability include human resources, financial resources, and information resources. Human resources include the organization's personnel and expertise involved in dependability. Financial resources include the organization's assets and capital facilities needed for dependability projects. Information resources include dependability knowledge base and intellectual properties owned by the organization. These three major resources jointly provide the organization with the essential dependability capability to successfully enter into business ventures and competition. Dependability resource management should reflect the vision, mission, and objectives of the organization's business plan and strategy. Further to these major resources, evidentially other resources like laboratories, manufacturing and testing resources might be needed in order to carry out dependability specific tasks, like component investigations, stress testing, software verification and validation, etc.

6.2 Resource planning, development and maintenance

6.2.1 Human resources

Resource planning should form part of the organization's business plan and strategy. Competence in dependability should be kept current to enable the organization to adapt to business and market changes. Personnel training and education are necessary to keep the knowledge current and to deal with technological advances.

6.2.2 Financial resources

Financial resource development for dependability should concentrate primarily on budget planning and implementation. Adequate financial resources should be made available for dependability programme tasks.

6.2.3 Information resources

Information resource development is critical for maintaining a current dependability knowledge base. Intellectual properties and patent registrations should be encouraged, recognized and awarded accordingly. Non-disclosure agreements should be considered when dealing with outside organizations on joint projects. Such agreements involve sharing or transferring of proprietary information where ownership of the information should be clearly identified in the contract agreement.

Information resource management involves the utilization of effective information flow process to drive innovation, work expediency and improvement by proper dissemination of relevant information to those who need it. Dependability programme tasks sometimes may require development or acquisition of sensitive information that could affect business results or hinder market competition. A control process for information security should be developed and maintained to protect sensitive data in storage, backup, transfer and dissemination, and from intrusion.

The process for managing controlled documents, intellectual properties, methods and procedures that affect dependability and the life cycle of products should be reviewed on a regular basis. The length of time that project documentation has to be retained for regulatory or statutory purposes should be clearly documented to facilitate declassification and destruction.

6.3 Outsourcing

Routine, short-term dependability programme tasks can be done by outsourcing or subcontracting the task externally. Typical examples include compliance testing, design of test tools, and data collection and analysis tasks. In such cases, supplier or contractor interface become important for the organization to maintain control of overall project commitments and product delivery schedules.

7 Product realization

7.1 Planning for product realization

Planning for product realization on dependability utilizes the product life cycle framework established in the dependability management process.

The product life cycle depicts the various phases that span the lifetime of a product. It can be used to define objectives, outcomes, processes and other time-dependent characteristics important to product dependability at each phase of the product life cycle. The separation of definable product life cycle phases can facilitate project management in terms of product realization. At each critical phase, investment decisions and resource commitments can be made and incorporated into the business management process. Dependability data assessed during each product life cycle phase can represent crucial information needed for management decisions to support rationale in project continuation and identification of improvement needs.

The product life cycle helps address the time dependent dependability issues at each phase of the product: concept, development, manufacture, installation, operation and maintenance, and disposal.

Establishing dependability programme objectives is a management responsibility. A dependability plan outlines the sequence of dependability activities associated with the product realization plan and tailored to meet specific product needs. The application of a dependability plan is provided in 7.3.

The creation of a dependability plan should consider the following:

- determination of specific dependability needs and expectations of the market or the customer;
- determination of how and in what environment the product will be used;
- determination of essential processes and prioritizing the time-phase implementation of dependability programme tasks to meet market or specific customer needs;
- assurance that market objectives or customer needs are met through verification and validation processes;
- obtain relevant dependability data for quality records to facilitate continual improvement.

7.2 Tailoring of dependability programmes

Tailoring is a process of selecting those tasks from a set of eligible tasks essential to meet a specific project objective. For effective implementation, the dependability programme should be tailored to meet the needs of the specific application. The objective of tailoring is to optimize the allocation of dependability resources. Specific dependability programme tasks relevant to the product life cycle phase or the project needs should be selected by tailoring.

The general tailoring process activities include the following:

- identification of the project environment reflecting the organizational policy and infrastructure;

- analysis of the contract stipulations, characteristics and objectives which may be difficult to realize and to deliver;
- capability and resources needed and actually available for project implementation;
- determination of the specific life cycle phase or phases applicable to the project;
- determination of the product related characteristics such as the product features and functions, past history of similar products, the intended end use of the product, and the anticipated application environments;
- selection of applicable dependability programme elements and tasks relevant to the specific life cycle phases identified;
- identification of the project's relevant system life cycle processes associated with the timing and duration of dependability programme elements and activity applications for resource allocation;
- documentation of the rationale in formalizing the tailoring decisions as part of the project plan.

Consideration should be given to the costs involved when tailoring a dependability programme to meet specific project objectives. Dependability effort selected for programme implementation should be rationalized to ensure that the selected activities add value. Guidelines for the tailoring process are described in Annex F. The output from the tailoring process should be a documented dependability plan.

7.3 Application of dependability plan

In applying a dependability plan to a product, it is important to address the dependability issues from a system viewpoint. In the system specification the expected operating conditions need to be defined and the interactions of the subsystems and system components need to be described, as far as necessary for dependability considerations. The availability performance of the system should be measured or assessed to validate the achievement of stated dependability objectives in terms of reliability, maintainability, and maintenance support.

The software aspect of dependability is associated with the integrity of the software component in system operation. Integrity is an inherent design attribute. The ability of a system and its software component to achieve a dependability objective is dependent on the system architecture, fault tolerant design, mitigation process and the degree of rigour in the application of relevant quality assurance or formal methods to the software development and maintenance process. The relationship between dependability and integrity is closely linked by the criticality of software application associated with the assigned integrity levels when dealing with the software affecting system performance. ISO/IEC 15026 describes the system and software integrity levels.

From a dependability perspective, the design of human-machine interfaces, the ease of operation and maintenance and the safety of humans who are operating, maintaining, using or disposing of the system should be considered.

The dependability programme elements should be integrated with other elements of the product development and production processes and the operational activities of the organization to maximize results and minimize costs.

7.4 Supply-chain management

The purchasing process includes supply-chain management, which is critical in dependability for product realization.

To achieve specified product dependability, the organization relies on the suppliers in providing components and services conforming to specified needs and applications in designing and manufacturing of the product. Examples include generic parts inventory, special devices, commercial test tools to facilitate systems integration; support services for product environmental impact evaluation and safety certification. In all cases, the contract